

Rice cooking process as an analogy of solidification process of early magma ocean

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In the rice cooking process several types of heat transfer are involved. At the first stage of heating rice grains are sufficiently heavier than water and a sedimentation layer is formed at bottom. This layered structure is controlled by convection of permeable flow in this layer. Rice grains gradually swell with water and density difference between water and grains becomes smaller, which forms suspension. More efficient heat transfer is brought about by this whole layer convection. Further swelling and decrease of water cause a drastic increase of volume fraction of solid phase, which changes the flow style. When the volume fraction of rice grain reaches the critical value the framework of solid phase is established. Heat transfer is controlled by permeable flow through the network of rice grains. By the interaction of flow and structure chimney-like localized conduits are formed. By further heating the flowing fluid changes from water to vapor. These successive changes in the heat transfer mode is closely correlated with the structural and the thermal evolution of this system. This system has strong analogy to the evolution of planetary interior.

In this presentation we report structural change of rice and water system during cooking process by observing visually the internal structure and by temperature measurements. A transparent glass pun which can be heated by IH heater (Iwaki Glass Co.) made this kind of observations possible. We present video images of evolution of the internal structure and discuss possible implications for heat transfer modes of magma ocean in planetary evolution.